



1
00:00:06,470 --> 00:00:02,950
hi i'm john tilke a nasa co-op and i'm

2
00:00:07,349 --> 00:00:06,480
here with steve bowen a retired navy

3
00:00:08,150 --> 00:00:07,359
captain

4
00:00:10,150 --> 00:00:08,160
and

5
00:00:12,390 --> 00:00:10,160
now a nasa astronaut

6
00:00:14,310 --> 00:00:12,400
thank you hi i wanted to ask you about

7
00:00:17,109 --> 00:00:14,320
your experience in the navy and how you

8
00:00:18,790 --> 00:00:17,119
guys use non-destructive evaluation

9
00:00:20,230 --> 00:00:18,800
when you're under c oh well

10
00:00:22,070 --> 00:00:20,240
non-destructive evaluation you actually

11
00:00:23,429 --> 00:00:22,080
use it all the time and obviously

12
00:00:25,029 --> 00:00:23,439
there's

13
00:00:26,630 --> 00:00:25,039

some highly controlled

14

00:00:28,950 --> 00:00:26,640

non-destructive evaluation that you get

15

00:00:30,870 --> 00:00:28,960

to use radiography in the shipyard in

16

00:00:32,389 --> 00:00:30,880

particular it's not something you can

17

00:00:34,389 --> 00:00:32,399

take underway with you not something you

18

00:00:37,110 --> 00:00:34,399

can take the space with you

19

00:00:39,830 --> 00:00:37,120

ultrasound for pipe wall thickness we

20

00:00:41,670 --> 00:00:39,840

use that vibration monitoring even sonar

21

00:00:43,990 --> 00:00:41,680

itself we use that on

22

00:00:46,790 --> 00:00:44,000

submarines to analyze ourselves and

23

00:00:48,229 --> 00:00:46,800

assess ourselves and space it's a

24

00:00:49,590 --> 00:00:48,239

similar it can be very similar at times

25

00:00:51,270 --> 00:00:49,600

obviously we do a lot of non-destructive

26

00:00:53,830 --> 00:00:51,280

evaluation on the ground

27

00:00:56,630 --> 00:00:53,840

for systems before we launch them

28

00:00:58,869 --> 00:00:56,640

i think the space shuttle

29

00:01:00,790 --> 00:00:58,879

external tank was a

30

00:01:03,270 --> 00:01:00,800

a really good example where they

31

00:01:04,630 --> 00:01:03,280

developed a very specific ultrasonic

32

00:01:05,910 --> 00:01:04,640

testing system

33

00:01:07,990 --> 00:01:05,920

before they shipped the tank it was

34

00:01:10,230 --> 00:01:08,000

pretty neat to go and see

35

00:01:11,590 --> 00:01:10,240

so non-destructive evaluation you know

36

00:01:13,750 --> 00:01:11,600

it's been in sort of everything i've

37

00:01:15,030 --> 00:01:13,760

done since i graduated from college has

38

00:01:16,310 --> 00:01:15,040

had some little

39

00:01:18,070 --> 00:01:16,320

part of it

40

00:01:20,550 --> 00:01:18,080

ensuring that the vehicles i've been

41

00:01:22,710 --> 00:01:20,560

living on have been safe to operate and

42

00:01:24,310 --> 00:01:22,720

it covers such a broad broad range of

43

00:01:26,870 --> 00:01:24,320

things

44

00:01:29,190 --> 00:01:26,880

i mentioned some of the more specific

45

00:01:30,710 --> 00:01:29,200

nde techniques but we even went to the

46

00:01:32,310 --> 00:01:30,720

point of you know you're tapping on a

47

00:01:33,990 --> 00:01:32,320

pipe and you're listening and feeling

48

00:01:36,390 --> 00:01:34,000

for the response

49

00:01:38,870 --> 00:01:36,400

as you go along and in space a lot of

50

00:01:40,390 --> 00:01:38,880

what you're doing is a similar you're

51
00:01:41,749 --> 00:01:40,400
listening to the vehicle itself you're

52
00:01:43,190 --> 00:01:41,759
listening for changes you're listening

53
00:01:45,510 --> 00:01:43,200
for

54
00:01:47,670 --> 00:01:45,520
things that are not quite right

55
00:01:49,830 --> 00:01:47,680
as you move around if things move a

56
00:01:52,310 --> 00:01:49,840
little bit differently and i know

57
00:01:54,389 --> 00:01:52,320
when we go out and do space walks the

58
00:01:55,510 --> 00:01:54,399
teams on the ground look at the video to

59
00:01:57,030 --> 00:01:55,520
see how

60
00:01:58,630 --> 00:01:57,040
our movements affect the vibration of

61
00:02:01,190 --> 00:01:58,640
the space station to

62
00:02:03,190 --> 00:02:01,200
to do some load testing so it's sort of

63
00:02:05,270 --> 00:02:03,200

an everything sort of question i guess

64

00:02:06,830 --> 00:02:05,280

when you ask it like that

65

00:02:09,109 --> 00:02:06,840

awesome

66

00:02:11,029 --> 00:02:09,119

so how long does it take for you to live

67

00:02:12,070 --> 00:02:11,039

in this kind of vehicle to get a feel

68

00:02:13,830 --> 00:02:12,080

for

69

00:02:16,229 --> 00:02:13,840

the health and that's actually an

70

00:02:18,309 --> 00:02:16,239

interesting question because you know we

71

00:02:21,350 --> 00:02:18,319

tend to fall back a lot on automated

72

00:02:25,750 --> 00:02:23,430

not always are they capable of picking

73

00:02:27,270 --> 00:02:25,760

up the subtleties and the trends and the

74

00:02:29,589 --> 00:02:27,280

the programming

75

00:02:32,869 --> 00:02:29,599

of the human mind so i always thought an

76
00:02:34,229 --> 00:02:32,879
intelligent operator was key to ensuring

77
00:02:35,750 --> 00:02:34,239
that we were getting the most out of

78
00:02:37,350 --> 00:02:35,760
this testing obviously you can go back

79
00:02:38,790 --> 00:02:37,360
and you take data from a vibration

80
00:02:41,270 --> 00:02:38,800
monitoring system

81
00:02:42,790 --> 00:02:41,280
and you can do a pretty high level

82
00:02:45,990 --> 00:02:42,800
assessment of what bearing is going to

83
00:02:47,670 --> 00:02:46,000
fail where the the problems are

84
00:02:49,830 --> 00:02:47,680
but somebody standing next to the pump

85
00:02:51,430 --> 00:02:49,840
doing that first cut often was able to

86
00:02:53,910 --> 00:02:51,440
pick up a lot of the stuff before we

87
00:02:55,270 --> 00:02:53,920
could even get it analyzed similarly on

88
00:02:58,390 --> 00:02:55,280

a

89

00:03:00,070 --> 00:02:58,400

listening

90

00:03:02,149 --> 00:03:00,080

carefully you you know what normal

91

00:03:04,710 --> 00:03:02,159

sounds like that's a very important

92

00:03:07,190 --> 00:03:04,720

thing or you know what normal looks like

93

00:03:08,869 --> 00:03:07,200

what it feels like it takes time to

94

00:03:10,550 --> 00:03:08,879

establish that

95

00:03:12,790 --> 00:03:10,560

you know it could be in terms of weeks

96

00:03:14,550 --> 00:03:12,800

or months

97

00:03:15,430 --> 00:03:14,560

there's always the anecdotal stories of

98

00:03:18,309 --> 00:03:15,440

the

99

00:03:20,710 --> 00:03:18,319

crew member on a submarine that hears a

100

00:03:22,390 --> 00:03:20,720

a squeeze you know a change in the tone

101

00:03:24,390 --> 00:03:22,400

that he associates with changing in

102

00:03:26,309 --> 00:03:24,400

depth and he and he reports it and

103

00:03:27,509 --> 00:03:26,319

suddenly the the boat is a little more

104

00:03:29,030 --> 00:03:27,519

concerned that they didn't know they

105

00:03:31,270 --> 00:03:29,040

were changing in depth

106

00:03:33,110 --> 00:03:31,280

you know it takes that sort of awareness

107

00:03:33,990 --> 00:03:33,120

in the vehicle you're living on and

108

00:03:37,270 --> 00:03:34,000

that's

109

00:03:39,350 --> 00:03:37,280

from the engineering side of it where we

110

00:03:41,430 --> 00:03:39,360

actually can take the data

111

00:03:43,270 --> 00:03:41,440

and have people who are experienced with

112

00:03:45,589 --> 00:03:43,280

the data as we are you know mission

113

00:03:47,190 --> 00:03:45,599

control down here with the space station

114

00:03:49,750 --> 00:03:47,200

they can look at the information they

115

00:03:51,430 --> 00:03:49,760

get back on the loads and the monitoring

116

00:03:53,350 --> 00:03:51,440

of like the uh

117

00:03:54,390 --> 00:03:53,360

cbms and

118

00:03:56,470 --> 00:03:54,400

that

119

00:03:58,630 --> 00:03:56,480

you know cmgs i should say the control

120

00:04:00,949 --> 00:03:58,640

memorizers they can look at that data

121

00:04:03,030 --> 00:04:00,959

and they can tell you ahead of time

122

00:04:04,869 --> 00:04:03,040

how they're operating and that that

123

00:04:06,550 --> 00:04:04,879

real-time monitoring is key to make sure

124

00:04:08,309 --> 00:04:06,560

that the vehicles are safe to live on

125

00:04:10,309 --> 00:04:08,319

and operate

126

00:04:13,110 --> 00:04:10,319

so you're talking about the

127

00:04:14,630 --> 00:04:13,120

aware user yes how important do you

128

00:04:16,870 --> 00:04:14,640

think for when you're doing long

129

00:04:19,030 --> 00:04:16,880

duration space exploration are those

130

00:04:21,670 --> 00:04:19,040

automated systems going to be

131

00:04:23,670 --> 00:04:21,680

for allowing you well that's actually uh

132

00:04:26,230 --> 00:04:23,680

something i've put a lot of thought into

133

00:04:27,430 --> 00:04:26,240

on a submarine we were

134

00:04:29,030 --> 00:04:27,440

you know we had initially started off

135

00:04:31,110 --> 00:04:29,040

with like a vibration monitoring system

136

00:04:33,189 --> 00:04:31,120

the electrician we'd have to go out to

137

00:04:35,110 --> 00:04:33,199

each individual pump we had points that

138

00:04:37,110 --> 00:04:35,120

we could take uh

139

00:04:39,030 --> 00:04:37,120

trying to get that wired in to a

140

00:04:41,510 --> 00:04:39,040

continuously monitoring system or the

141

00:04:44,230 --> 00:04:41,520

ability to monitor when we wanted to

142

00:04:46,469 --> 00:04:44,240

and i think that that capability is even

143

00:04:48,230 --> 00:04:46,479

more important on like a space vehicle

144

00:04:49,350 --> 00:04:48,240

where you don't have that size crew for

145

00:04:50,790 --> 00:04:49,360

one you're not going to have the same

146

00:04:51,590 --> 00:04:50,800

number of intelligent operators out

147

00:04:53,430 --> 00:04:51,600

there

148

00:04:55,270 --> 00:04:53,440

listening aware of everything that's

149

00:04:56,629 --> 00:04:55,280

going on so they're going to need that

150

00:04:58,790 --> 00:04:56,639

data but you'll need people on the

151
00:05:01,590 --> 00:04:58,800
ground who can read and understand that

152
00:05:03,749 --> 00:05:01,600
data so you can pick up the problems

153
00:05:05,590 --> 00:05:03,759
before they become problems because

154
00:05:06,629 --> 00:05:05,600
oftentimes you can change the way you

155
00:05:10,469 --> 00:05:06,639
operate

156
00:05:12,469 --> 00:05:10,479
for a longer period of time

157
00:05:13,670 --> 00:05:12,479
or more safely

158
00:05:15,670 --> 00:05:13,680
with a

159
00:05:17,350 --> 00:05:15,680
you know a degrading system as opposed

160
00:05:19,350 --> 00:05:17,360
to a failed system if you continue to

161
00:05:21,590 --> 00:05:19,360
operate as it is

162
00:05:22,790 --> 00:05:21,600
so as we go forward we need to look

163
00:05:24,310 --> 00:05:22,800

and figure out

164

00:05:25,590 --> 00:05:24,320

how we're going to do that assessment

165

00:05:27,110 --> 00:05:25,600

without

166

00:05:29,510 --> 00:05:27,120

sort of the crew time and the crew

167

00:05:31,510 --> 00:05:29,520

tasking the crew members

168

00:05:33,909 --> 00:05:31,520

there to do it

169

00:05:35,189 --> 00:05:33,919

we can obviously send the information

170

00:05:37,189 --> 00:05:35,199

back to the ground we can have whole

171

00:05:38,790 --> 00:05:37,199

teams look at it but it's always going

172

00:05:40,550 --> 00:05:38,800

to be that first cut as it passes

173

00:05:42,710 --> 00:05:40,560

through that's guy that's going to pick

174

00:05:45,430 --> 00:05:42,720

up the the problems initially

175

00:05:47,350 --> 00:05:45,440

so any vehicle you build at this point

176

00:05:49,110 --> 00:05:47,360

you really need to put in different

177

00:05:51,350 --> 00:05:49,120

monitoring systems like you can you can

178

00:05:53,510 --> 00:05:51,360

imagine all sorts of interesting

179

00:05:56,150 --> 00:05:53,520

ways of looking at you know fluid

180

00:05:58,710 --> 00:05:56,160

systems and piping and

181

00:05:59,430 --> 00:05:58,720

you know vibration on pumps and motors

182

00:06:02,870 --> 00:05:59,440

and

183

00:06:06,230 --> 00:06:04,230

measurements that

184

00:06:07,909 --> 00:06:06,240

that can help you understand the

185

00:06:11,110 --> 00:06:07,919

performance of the vehicle that data

186

00:06:13,029 --> 00:06:11,120

just needs to get back to the ground or

187

00:06:15,430 --> 00:06:13,039

back to where the people can assess it

188

00:06:17,189 --> 00:06:15,440

on a submarine obviously it was on board

189

00:06:19,189 --> 00:06:17,199

for most but we would send data off

190

00:06:20,950 --> 00:06:19,199

periodically to to get other people look

191

00:06:22,950 --> 00:06:20,960

at it as well but it's

192

00:06:25,510 --> 00:06:22,960

it's vitally important for the long-term

193

00:06:26,230 --> 00:06:25,520

health of the vehicle and it might lead

194

00:06:35,430 --> 00:06:26,240

you

195

00:06:37,350 --> 00:06:35,440

that's degrading rapidly

196

00:06:39,270 --> 00:06:37,360

as opposed to if something fails

197

00:06:40,710 --> 00:06:39,280

outright that you could have detected

198

00:06:42,870 --> 00:06:40,720

earlier

199

00:06:45,670 --> 00:06:42,880

usually that's a lot worse than

200

00:06:47,029 --> 00:06:45,680

operating with a degrading system

201

00:06:49,510 --> 00:06:47,039

so

202

00:06:51,510 --> 00:06:49,520

obviously knowing your system as it's

203

00:06:53,670 --> 00:06:51,520

degrading is important but you've had a

204

00:06:55,270 --> 00:06:53,680

lot of experience with evas

205

00:06:56,870 --> 00:06:55,280

and going out and fixing things after

206

00:06:58,950 --> 00:06:56,880

they've broken yeah

207

00:07:00,390 --> 00:06:58,960

yeah unfortunately that's usually

208

00:07:02,870 --> 00:07:00,400

when you do stuff i had a lot of

209

00:07:05,670 --> 00:07:02,880

construction which was good

210

00:07:08,390 --> 00:07:05,680

on sts-126 we went out we went out and

211

00:07:10,950 --> 00:07:08,400

looked at the starboard

212

00:07:12,309 --> 00:07:10,960

sarge you know the large rotary joint

213

00:07:13,749 --> 00:07:12,319

which had

214

00:07:15,110 --> 00:07:13,759

damage to

215

00:07:17,029 --> 00:07:15,120

the surface

216

00:07:18,469 --> 00:07:17,039

of one of the bearings

217

00:07:20,150 --> 00:07:18,479

and

218

00:07:22,309 --> 00:07:20,160

you know they they had detected the

219

00:07:25,270 --> 00:07:22,319

anomalies in the vibration

220

00:07:26,950 --> 00:07:25,280

of the array in the motor currents

221

00:07:28,390 --> 00:07:26,960

for the drive motors and when the first

222

00:07:30,150 --> 00:07:28,400

people went out looked at it you could

223

00:07:31,510 --> 00:07:30,160

see the metal filings so we went and

224

00:07:33,270 --> 00:07:31,520

cleaned that up

225

00:07:34,950 --> 00:07:33,280

and we applied a

226

00:07:37,189 --> 00:07:34,960

layer of lubricant

227

00:07:39,029 --> 00:07:37,199

and returned it to full service which is

228

00:07:40,870 --> 00:07:39,039

i think pretty amazing

229

00:07:42,870 --> 00:07:40,880

but what they had done prior to that

230

00:07:44,550 --> 00:07:42,880

they actually had you know constrained

231

00:07:47,749 --> 00:07:44,560

the operations of that

232

00:07:49,909 --> 00:07:47,759

solar alpha joint rotary joint so that

233

00:07:52,070 --> 00:07:49,919

it would survive it survived long enough

234

00:07:54,150 --> 00:07:52,080

for us to be able to go and

235

00:07:56,150 --> 00:07:54,160

do a little bit of maintenance you know

236

00:07:57,029 --> 00:07:56,160

if it had if they had continued to run

237

00:08:00,469 --> 00:07:57,039

it

238

00:08:01,990 --> 00:08:00,479

running correctly

239

00:08:03,589 --> 00:08:02,000

you could have seized it up and it never

240

00:08:06,390 --> 00:08:03,599

would have been operational so that's a

241

00:08:08,550 --> 00:08:06,400

really good example of where

242

00:08:11,510 --> 00:08:08,560

that knowledge that monitoring of

243

00:08:14,070 --> 00:08:11,520

of a system allows to go and repair it

244

00:08:15,510 --> 00:08:14,080

and extend its life and because of that

245

00:08:16,710 --> 00:08:15,520

you know we lubricate the other side as

246

00:08:18,790 --> 00:08:16,720

well now

247

00:08:20,550 --> 00:08:18,800

and hopefully that will allow it to last

248

00:08:22,309 --> 00:08:20,560

the life of station

249

00:08:23,909 --> 00:08:22,319

so when you have something that lasts as

250

00:08:25,110 --> 00:08:23,919

long as a space station it's important

251
00:08:26,790 --> 00:08:25,120
to

252
00:08:28,710 --> 00:08:26,800
kind of regenerate your workforce and

253
00:08:30,790 --> 00:08:28,720
transfer that knowledge of operations

254
00:08:32,550 --> 00:08:30,800
and how things are run on to the younger

255
00:08:35,670 --> 00:08:32,560
generation yeah and that that's an

256
00:08:37,110 --> 00:08:35,680
interesting thing because sometimes

257
00:08:39,110 --> 00:08:37,120
the old guys sit around they tell

258
00:08:41,110 --> 00:08:39,120
stories you know they've gathered up all

259
00:08:43,589 --> 00:08:41,120
this experience over

260
00:08:45,350 --> 00:08:43,599
a lifetime of working well

261
00:08:47,430 --> 00:08:45,360
the space program is you know over 50

262
00:08:49,590 --> 00:08:47,440
years old now and there actually are

263
00:08:51,269 --> 00:08:49,600

very few of those old old guys

264

00:08:52,470 --> 00:08:51,279

left and the retirement of the shuttle

265

00:08:55,110 --> 00:08:52,480

there was a whole nother wave of

266

00:08:56,150 --> 00:08:55,120

tremendous experience that walked out

267

00:08:58,310 --> 00:08:56,160

the door

268

00:09:00,150 --> 00:08:58,320

and capturing that knowledge

269

00:09:01,430 --> 00:09:00,160

is difficult because a lot of times you

270

00:09:03,190 --> 00:09:01,440

learn things

271

00:09:05,590 --> 00:09:03,200

as they happen that experience that you

272

00:09:07,829 --> 00:09:05,600

get when something happens you know the

273

00:09:10,150 --> 00:09:07,839

first time the second time that just

274

00:09:11,670 --> 00:09:10,160

gets ingrained into how you operate how

275

00:09:13,990 --> 00:09:11,680

you do things

276
00:09:15,509 --> 00:09:14,000
that doesn't always make it obvious that

277
00:09:18,389 --> 00:09:15,519
you need to pass that on to the next

278
00:09:20,070 --> 00:09:18,399
person who won't have had that initial

279
00:09:21,190 --> 00:09:20,080
experience it's just something you kind

280
00:09:24,470 --> 00:09:21,200
of know

281
00:09:26,389 --> 00:09:24,480
so i think that there's a uh

282
00:09:28,790 --> 00:09:26,399
that knowledge of how the space station

283
00:09:31,670 --> 00:09:28,800
in particular operates as we proceed

284
00:09:33,030 --> 00:09:31,680
hopefully for another you know 14 15 16

285
00:09:34,870 --> 00:09:33,040
years of operation with the space

286
00:09:37,350 --> 00:09:34,880
station we'll see a whole nother

287
00:09:39,269 --> 00:09:37,360
generation of operators who come along

288
00:09:41,590 --> 00:09:39,279

and it'll be important

289

00:09:43,670 --> 00:09:41,600

that everybody that was there when we

290

00:09:45,430 --> 00:09:43,680

first detected the motor currents on the

291

00:09:47,190 --> 00:09:45,440

sarge or

292

00:09:50,550 --> 00:09:47,200

would notice the torn

293

00:09:53,030 --> 00:09:50,560

radiator panel and those those items we

294

00:09:54,310 --> 00:09:53,040

need to be able to pass on what were the

295

00:09:57,350 --> 00:09:54,320

cues what were the things that we

296

00:09:58,790 --> 00:09:57,360

learned what were the changes

297

00:10:01,110 --> 00:09:58,800

because if we don't pass that

298

00:10:02,949 --> 00:10:01,120

information on you won't they won't have

299

00:10:04,389 --> 00:10:02,959

that knowledge as when something else

300

00:10:06,550 --> 00:10:04,399

dramatically changes

301
00:10:08,710 --> 00:10:06,560
at the same time

302
00:10:10,550 --> 00:10:08,720
having a history of this having

303
00:10:13,110 --> 00:10:10,560
that long-term data that you've

304
00:10:15,509 --> 00:10:13,120
collected over time so you can see how

305
00:10:17,910 --> 00:10:15,519
something degrades over the life of the

306
00:10:19,190 --> 00:10:17,920
vehicle what we learned from this

307
00:10:21,509 --> 00:10:19,200
vehicle

308
00:10:23,670 --> 00:10:21,519
will be tremendously helpful as we go on

309
00:10:25,829 --> 00:10:23,680
provided we learn the lessons and we

310
00:10:27,190 --> 00:10:25,839
understand how

311
00:10:29,269 --> 00:10:27,200
how it's going to degrade and what that

312
00:10:30,630 --> 00:10:29,279
means operationally and how we can

313
00:10:33,350 --> 00:10:30,640

extend

314

00:10:35,190 --> 00:10:33,360

operations to to meet the requirements

315

00:10:37,110 --> 00:10:35,200

and what we need to do along the way and

316

00:10:39,030 --> 00:10:37,120

what systems what do we what knowledge

317

00:10:41,509 --> 00:10:39,040

are we missing you know what was not

318

00:10:43,430 --> 00:10:41,519

built into space station that would

319

00:10:44,710 --> 00:10:43,440

would have been helpful along the way

320

00:10:47,910 --> 00:10:44,720

that would have given us a little better

321

00:10:49,990 --> 00:10:47,920

insight into its operation and

322

00:10:52,389 --> 00:10:50,000

its aging process that that'll be

323

00:10:54,069 --> 00:10:52,399

interesting to see over time

324

00:10:56,230 --> 00:10:54,079

so what can you say to students to help

325

00:10:59,430 --> 00:10:56,240

inspire them to take up fields

326

00:11:01,030 --> 00:10:59,440

particularly in like nde well see as i

327

00:11:03,670 --> 00:11:01,040

was discussing earlier nde is such a

328

00:11:04,630 --> 00:11:03,680

broad all-encompassing term i

329

00:11:06,790 --> 00:11:04,640

i know

330

00:11:08,150 --> 00:11:06,800

uh from my experience

331

00:11:10,630 --> 00:11:08,160

i had the good fortune of being engineer

332

00:11:12,949 --> 00:11:10,640

of a submarine and spent a little bit of

333

00:11:14,870 --> 00:11:12,959

time in a shipyard environment actually

334

00:11:17,590 --> 00:11:14,880

even as a junior officer

335

00:11:18,470 --> 00:11:17,600

i think i spent a lot more time

336

00:11:20,710 --> 00:11:18,480

uh

337

00:11:22,069 --> 00:11:20,720

than the guys actually wanted me to you

338

00:11:24,389 --> 00:11:22,079

know talking to the sonar attacks

339

00:11:25,990 --> 00:11:24,399

talking to the electricians uh talking

340

00:11:28,230 --> 00:11:26,000

to the radiographers as they came on

341

00:11:29,910 --> 00:11:28,240

board the ultrasound technicians i

342

00:11:32,310 --> 00:11:29,920

always had a lot more questions is

343

00:11:34,069 --> 00:11:32,320

because it's it's an amazing concept

344

00:11:35,430 --> 00:11:34,079

that you can do something

345

00:11:37,110 --> 00:11:35,440

that's uh

346

00:11:39,990 --> 00:11:37,120

you're not violating

347

00:11:41,829 --> 00:11:40,000

the operational construct of the of the

348

00:11:42,710 --> 00:11:41,839

system whether it be the piping system

349

00:11:45,910 --> 00:11:42,720

or the

350

00:11:48,230 --> 00:11:45,920

and you're learning a lot you're

351
00:11:50,870 --> 00:11:48,240
understanding how it operates

352
00:11:52,310 --> 00:11:50,880
within it you know and encompasses such

353
00:11:54,629 --> 00:11:52,320
a broad range

354
00:11:56,710 --> 00:11:54,639
of uh

355
00:11:57,670 --> 00:11:56,720
science actually you know i

356
00:11:59,030 --> 00:11:57,680
i

357
00:12:00,949 --> 00:11:59,040
had a

358
00:12:02,150 --> 00:12:00,959
professor when i was in graduate school

359
00:12:04,629 --> 00:12:02,160
who said

360
00:12:06,069 --> 00:12:04,639
a wave is a wave he had actually been a

361
00:12:07,990 --> 00:12:06,079
nuclear engineer

362
00:12:09,350 --> 00:12:08,000
and he was teaching acoustics at a woods

363
00:12:11,829 --> 00:12:09,360

hole

364

00:12:13,990 --> 00:12:11,839

and he said you know it really is all

365

00:12:16,550 --> 00:12:14,000

part of the same problem you know and he

366

00:12:18,870 --> 00:12:16,560

was doing acoustic tomography which to

367

00:12:21,190 --> 00:12:18,880

assess ocean environments but in essence

368

00:12:22,629 --> 00:12:21,200

that is ultrasound you know in a

369

00:12:25,750 --> 00:12:22,639

different frequency range different

370

00:12:27,190 --> 00:12:25,760

scale but it's you know understanding uh

371

00:12:29,190 --> 00:12:27,200

the information you're getting back and

372

00:12:32,310 --> 00:12:29,200

what that's telling you

373

00:12:33,750 --> 00:12:32,320

is uh is incredible and then for me it

374

00:12:36,310 --> 00:12:33,760

was you know

375

00:12:39,350 --> 00:12:36,320

you see this piping system and you know

376

00:12:41,590 --> 00:12:39,360

fluid is flowing through there

377

00:12:45,269 --> 00:12:41,600

over time what is that doing to the

378

00:12:48,629 --> 00:12:45,279

interior of that piping is it is it

379

00:12:50,470 --> 00:12:48,639

is it corroding is it just eroding is it

380

00:12:52,069 --> 00:12:50,480

staying pristine is it putting a nice

381

00:12:54,470 --> 00:12:52,079

little protective coating of something

382

00:12:56,230 --> 00:12:54,480

else on there

383

00:12:57,990 --> 00:12:56,240

so the ability to look at that and

384

00:13:00,230 --> 00:12:58,000

assess that and understand

385

00:13:02,629 --> 00:13:00,240

those

386

00:13:05,750 --> 00:13:02,639

aspects of the system as they as they

387

00:13:07,110 --> 00:13:05,760

get used is is pretty pretty cool and

388

00:13:09,590 --> 00:13:07,120

you know a lot of ways it's very

389

00:13:10,790 --> 00:13:09,600

exciting and

390

00:13:12,470 --> 00:13:10,800

yeah

391

00:13:13,910 --> 00:13:12,480

i probably asked way too many questions

392

00:13:16,069 --> 00:13:13,920

of those guys who knows how many man

393

00:13:18,470 --> 00:13:16,079

hours i used up quizzing them because i

394

00:13:20,710 --> 00:13:18,480

just think it's it's a very exciting

395

00:13:22,629 --> 00:13:20,720

field actually fields

396

00:13:24,710 --> 00:13:22,639

i actually used an ir camera we had an

397

00:13:27,030 --> 00:13:24,720

ir camera on the boat and

398

00:13:29,350 --> 00:13:27,040

uh it was we had used it on board we had

399

00:13:30,870 --> 00:13:29,360

it on board for firefighting reasons

400

00:13:33,030 --> 00:13:30,880

but we had started to use them for cable

401
00:13:34,710 --> 00:13:33,040
inspections and we were able to identify

402
00:13:36,629 --> 00:13:34,720
different you know a cables with

403
00:13:39,269 --> 00:13:36,639
different problems and get them repaired

404
00:13:40,389 --> 00:13:39,279
by using an ir camera and

405
00:13:41,829 --> 00:13:40,399
so i think

406
00:13:44,150 --> 00:13:41,839
learning from that

407
00:13:46,790 --> 00:13:44,160
it's just amazing what you can

408
00:13:50,150 --> 00:13:46,800
do with some of these techniques and

409
00:13:52,310 --> 00:13:50,160
such a broad broad just wealth of places

410
00:13:53,110 --> 00:13:52,320
to look and it extends you know what you

411
00:13:55,590 --> 00:13:53,120
learn

412
00:13:57,750 --> 00:13:55,600
uh maybe in one area as i pointed out

413
00:13:58,870 --> 00:13:57,760

will carry forth into other areas as

414

00:14:00,069 --> 00:13:58,880

well

415

00:14:01,590 --> 00:14:00,079

steve thank you so much for coming to